
The Cost Modeling Process

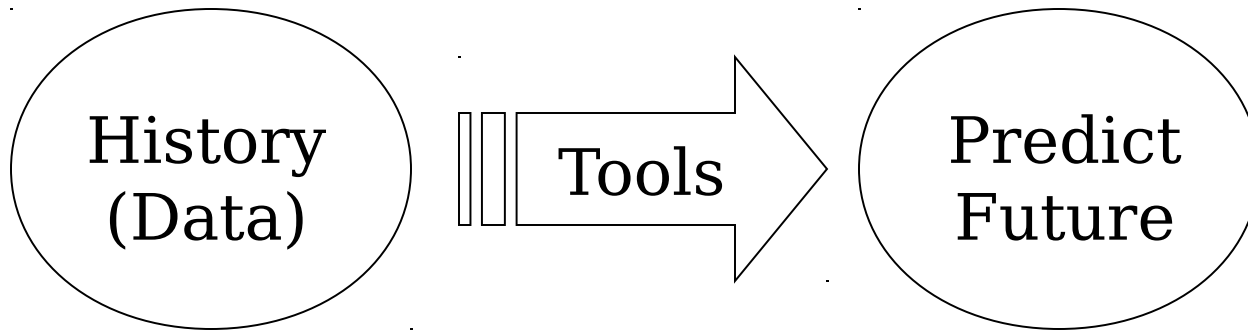
Chapter 5

Introduction

- **What makes a good cost model?**
 - **Good Statistics**
 - **Quality Data**
 - **Relevant Data**
 - **Analogous or Applicable Data**
 - **“Causality” between independent and dependent variables**

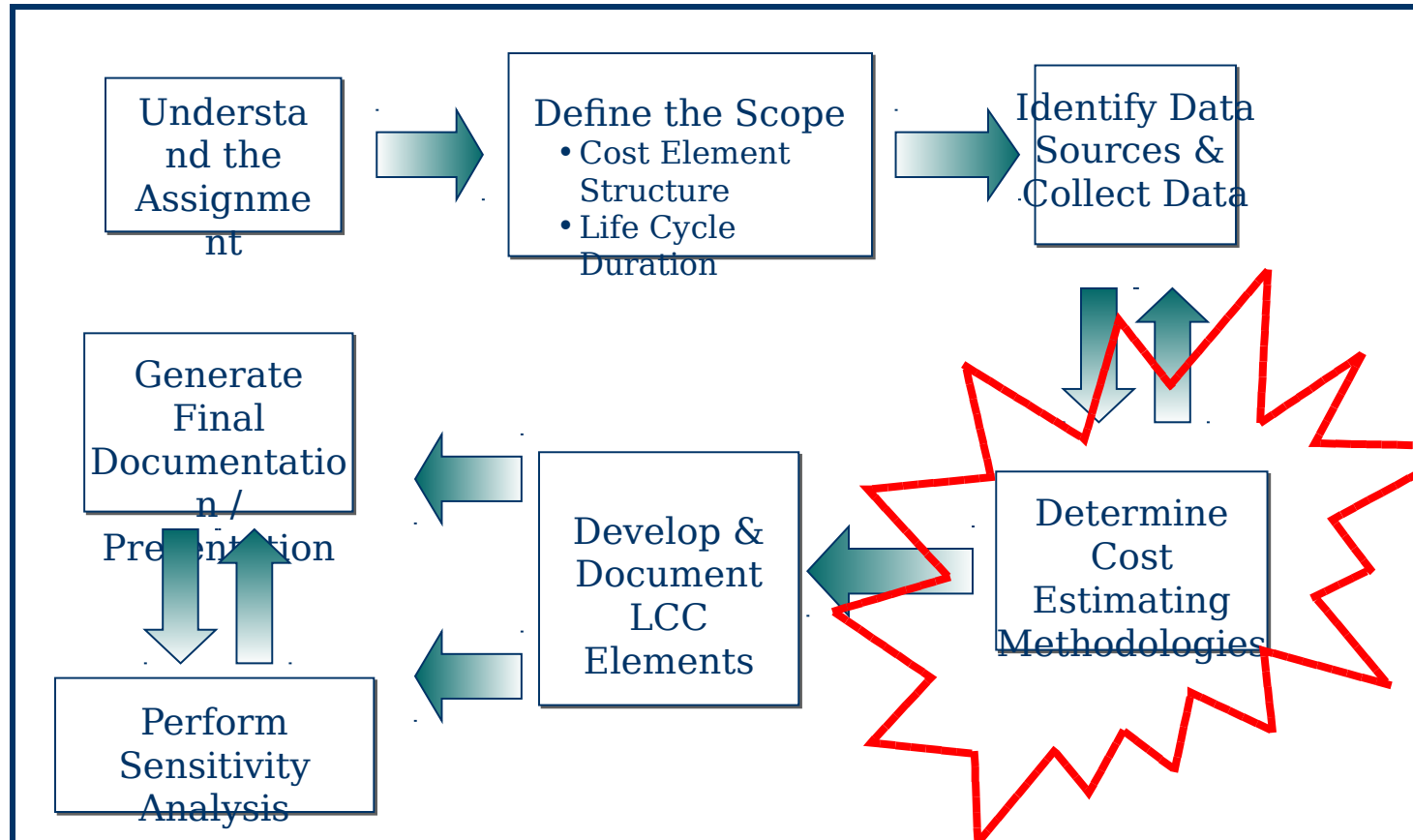
The Cost Estimating Process

- **Estimates are always based on history...otherwise, they are mere guesses.**



- **We use the tools to make the historical data look as much as possible like the future system.**

LCCE Process



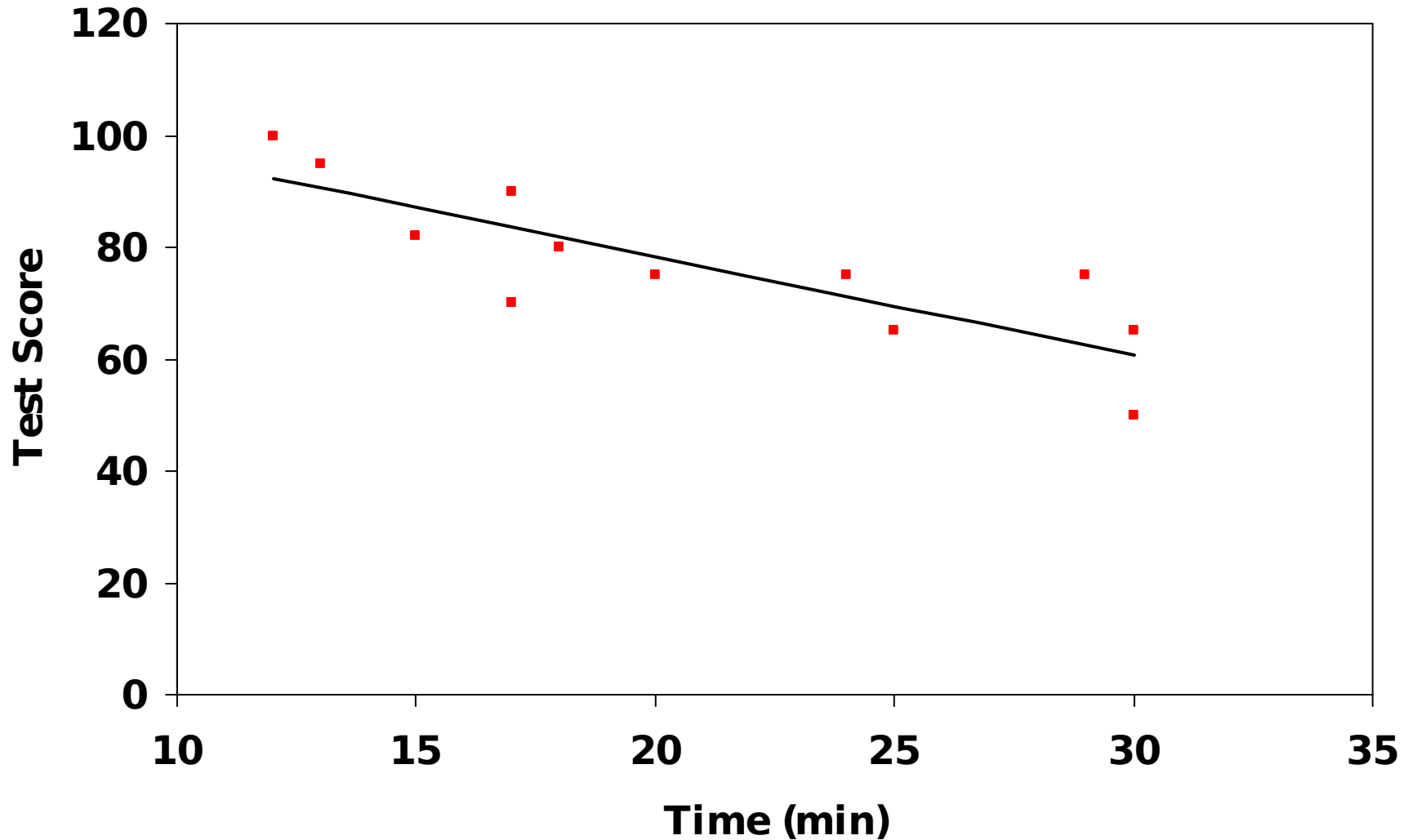
The Modeling Process

- **Identification of potential cost drivers**
- **Specification of functional forms**
- **Selection of analogous systems**
- **Data Collection**
- **Data Normalization**

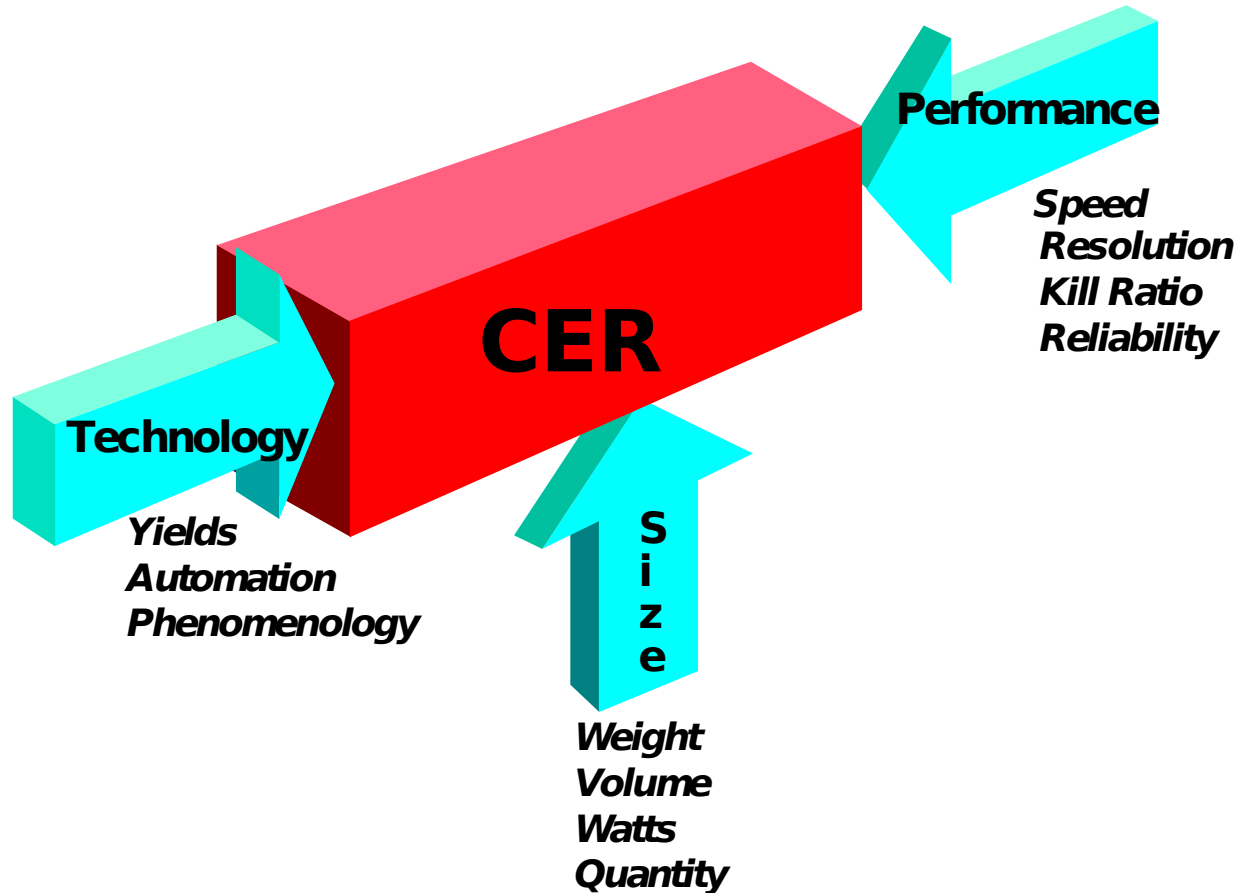
Identification

- **Determine what “causes” cost for each cost element**
- **Question experts from government and industry**
- **Identify major cost drivers**
 - **Technology**
 - **Size**
 - **Performance**

Causality (Correlation)



Building a Cost Estimating Relation (CER)



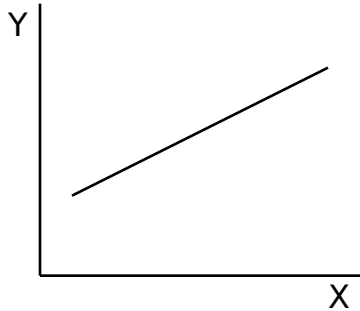
Cost Drivers

- **Technology**
 - **New, high risk technology is generally more expensive than existing technology**
 - **Difficult to capture**
- **Size**
 - **Generally, the bigger, the more expensive**
 - **Easy to capture**
- **Performance**
 - **The greater the performance, the higher the cost**
 - **Also easy to capture**

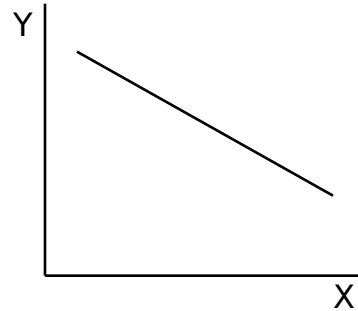
Specification

- **Determination of functional form**
- **The functional form must make sense**
- **Avoid letting the data determine the shape of the line (unless you have a lot of it)**
- **Get engineering opinions if possible**
- **Remember the goal is to obtain good predictions, not good statistics**
- **Make sure cost behaves as expected when the cost driver varies**

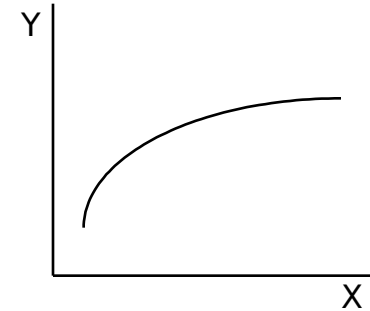
Specification



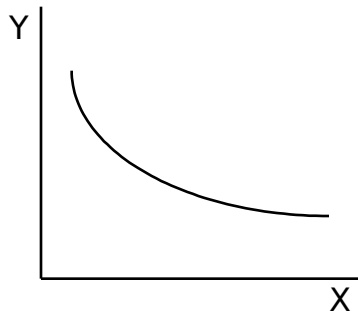
Increasing at a steady rate



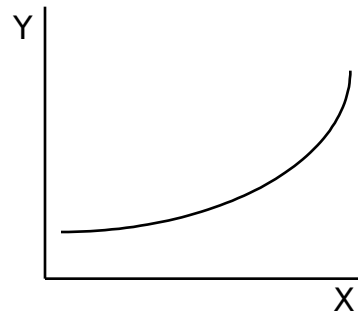
Decreasing at a steady rate



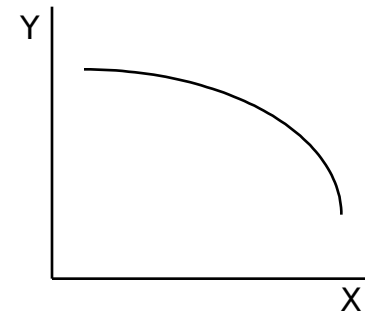
Increasing at a decreasing rate



Decreasing at a decreasing rate



Increasing at an increasing rate



Decreasing at an increasing rate

Selecting Analogous Systems

- **Ideally, we would like systems that smell, taste and look like the items we will be estimating**
- **In reality, DoD has few systems which employ similar technology, performance and size**
- **In general, do not overly constrain yourself when selecting analogous tasks**
- **In order to be called “analogous” the system need only have a similar cost driver and a similar functional form when mapped to cost**

Collecting Data

- **Select systems relevant to system being costed**
 - **Choose analogous systems or components based upon elements identified/defined in WBS**
 - **Typical cost drivers include physical and performance characteristics**
 - » **physical characteristics: weight, volume, number of holes drilled, number of parts to assemble, materials of composition, etc.**
 - » **performance characteristics: power, thrust, bandwidth, range, speed, etc.**
 - **Improvements in technology are an extremely important consideration**
 - » **measures of technology include: % composite material, radar cross section, etc.**

Collecting Data

- Identify relevant historical cost, technical, and programmatic data to be collected
 - Program schedule, development quantity, production quantity
 - Physical and performance data from operating (NATOPS) manuals, manufacturer's specifications, test data

Data Sources

- **Data sources include any or all of the following: contractor accounting records, contractor cost data reports (CCDR), cost performance reports (CPR), cost/schedule status reports (C/SSR), cost proposals/bids, or other sources within industry and government**
 - **Common denominator is *contractor***

Data Analysis

- **Review data collected to insure homogeneity (i.e., standard quantities, constant \$), adequate coverage of all WBS elements, consistency with proposed system complexity**
- **Allocate data to WBS elements**
 - **Organize data on a consistent basis (system to system, contractor to contractor, WBS element to WBS element)**
 - **Ideally would like to distinguish between recurring and non-recurring costs, support costs, direct and indirect costs, profit**
- **Identify problems and anomalies with the data**
 - **Gaps in data, jumps in technology, type of program (design to cost vs. other), major failures in development/testing phase, strike by work force, etc.**

Data Analysis

- **Normalize the data as necessary**
 - **Consistent units/elements of cost**
 - **Adjust for inflation**
 - **Develop learning curve to adjust for quantity differences**
 - » **1st unit cost**
 - **Account for absent cost items, remove inapplicable cost items**

Develop Cost Estimate

- **Four common approaches to developing a Cost Estimating Relationship (CER)**
 - **Analogy**
 - **Engineering cost estimate**
 - **Expert opinion**
 - **Statistical/parametric approach**